

REMARKS

Claims 1-14 have been presented for examination. Claims 1through 14 inclusive were rejected by Office Action mailed September 16, 2003.

In his analysis, the Examiner correctly observes that a motivation for the invention is a desire to attenuate the number of photons and neutral particles reaching the detector. The invention recognizes that the contributions to detector noise from energetic neutrals and photons are not limited to a single discrete source, e.g., the primary ion source (usually an inductively coupled plasma). Moreover the invention as a whole is intended to be an efficient and precise mass analyzer exhibiting an enhanced sensitivity over the widest possible mass range.

Note from any of figures 1 through 6 inclusive, that the primary source of photons and neutrals, the ICP, emits ions, neutrals and photons from an aperture and along a first axis at an angle to DC electric field. This electric field is sustained between a segmented annular electrode and a facing planar electrode. The annular electrode provides a rather large aperture through which the neutrals and photons continue on the original path substantially along the first axis, while the electric field rotates the trajectory of the ion beam to a second axis. As viewed in reverse along the second axis, the angle is such that the primary source (of neutrals and photons) is not seen by a detector situated on the second axis. Notwithstanding this technique for removing neutrals and photons from incidence with the detector, the noise prevalent in the detector is found to be excessive. The invention has recognized that a second, distributed source of neutrals and photons is attributed to the portion of the trajectory of the ion beam in a region of relatively high pressure (first vacuum region). This region of the ion beam trajectory is at a pressure intermediate the third chamber 48 (quadrupole analyzer section at 10^{-5} Torr, p. 13, line 16-19) and a chamber 20 at 2 to 4 Torr(p.11,lines13-24). The chamber 20 has no other designation in the specification; consequently an "initial region" is thought adequate to so designate this portion of the apparatus. Applicant is receptive to any alternative suggestion that the Examiner may supply. The pressure in the second chamber 28 provides a distributed target medium for the energetic ion beam to undergo reactions forming

neutrals and photons along the beam trajectory and thus directly on a line of sight to the detector 46 unless the further inventive structure is inserted to provide a baffle for the detector from this secondary source of noise. Portions of the added limitations to claim 1, offered herein, point out the intermediate pressure of the first vacuum region. One of skill in the art recognizes that this region thus constitutes a region of enhanced target density for interactions with the ion beam and these interactions may yield neutrals and photons.

A quadrupole analyzer presents a field discontinuity to the beam entering the analyzer. It is known to reduce this discontinuity through fringe field trimming as described in the references. However, the fringe field trim function is not to be ascribed to one of any pair of quadrupole sections, as for example a quadrupole doublet shown in the Brubaker '020 reference. In the latter reference, a curved section of analyzer operated at relatively low resolving power is disposed ahead of a linear section of quadrupole operated at a relatively high resolving power and it is observed there that this will provide reduction in photons from a primary source, e.g., the charged particle source as viewed by the detector. What '020 describes is a (then) conventional mass analyzer wherein high vacuum is uniformly desirable throughout the system. In the present ICP MS art, a free expansion jet is prescribed from near atmospheric pressure to a modest vacuum condition, followed by progressively better vacuum conditions in succeeding regions of the instrument. The non-negligible pressure on a sight line from the detector is deleterious to the ICP-MS instrument, even though the primary source of neutrals and photons be out of view: such situation does not arise for the '020 reference. The fringe field electrode trim set has found a further use by causing it to at once serve as an ion guide/ analyzer enhancement and also by configuring same to present its bulk as a shield for the detector. The Yamada reference '718 presents a pre-analysis mass filter in the form of an octupole ion guide at the expense of a necessary dimensional extension to accommodate this component. In contrast the dipole field between ring electrode 42 and electrode 40 for the present invention removes undesired constituents from the primary beam, without the inconvenience of an extended dimension for the second chamber 28 as required for a quadrupole field ion guide.

The amended claim 1 states additional limitations regarding the intermediate nature of the pressure in the first vacuum region, that is a region which is associated with a secondary, distributed source of neutrals and de-excitation photons arising from interactions with the primary beam. The diversion of the ion beam through "a first angle" is recognized in the claim as not enough in itself to protect the detector from the unwanted response to noise associated with the neutrals and photons arising in the (now) diverted beam: the mass analyzer is further shielded therefrom by the artifice of the configuration of the quadrupole fringe electrodes. The several means of such configuration are properly left to dependent claims inasmuch as "shielding" is recognized as a function of the bulk mass of these electrodes.

New dependent claim 15 has antecedent basis at p. 11, lines 13-24 and p. 13, lines 16-19.

The Examiner requested to submit an abstract on a separate sheet. The abstract of the disclosure is submitted herewith.

The Applicant will submit the information disclosure statement with list of the publications cited in the subject application that have not been cited by the Examiner by separate submission.

The Examiner acknowledged the Applicant claim for foreign priority based on an application filed in Australia on April 27, 2001, but noticed that the priority document was not filed. A certified copy of the priority document is filed concurrently herewith.

In view of the amendments and Certified copy submission the Examiner is respectfully requested to pass the subject application to issue.

Respectfully submitted,



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